PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of

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and Carsten **PLOG**

Appln. No.:

Filed: **July 24, 2001**

For: **PROCESS FOR DENITRIFICATION AND EXHAUST GASSES, PARTICULARLY FOR LEAN OPERATED INTERNAL COMBUSTION ENGINES**

Attorney Docket No.: **3926.030**

PRELIMINARY AMENDMENT

Box: **PATENT APPLICATION**
Honorable Commissioner of
Patents and Trademarks
Washington, D.C. 20231

Sir:

Prior to examination of the above-identified application, please amend the application as follows:

Replacement pages 1, 3 and 5 are provided wherein the following amendments are made in the specification:

IN THE SPECIFICATION:

Page 1, before paragraph [0001] insert:

BACKGROUND OF THE INVENTION

Field of the Invention

Page 1, paragraph [0001], lines 2-3, delete "according to ... Claim 1".

Page 1, before paragraph [0002] insert:

Description of the Related Art

Page 3, before paragraph [0008] insert:

SUMMARY OF THE INVENTION

Page 3, delete paragraph [0009] in its entirety.

Page 5, before paragraph [00016] insert:

BRIEF DESCRIPTION OF THE DRAWINGS

Page 5, before paragraph [00017] insert:

DETAILED DESCRIPTION OF THE INVENTION

IN THE CLAIMS:

Page 8, line 1, please delete "PATENT CLAIMS", delete claims 1-8 and add the following new Claims 9-16:

WHAT IS CLAIMED IS:

9. Process for denitrification of exhaust gasses of an internal combustion engine operated primarily in the lean phase including the following process steps:

- placing in the exhaust gas stream of the internal combustion engine a nitrogen oxide storing and catalytically effective solid which is free of alkali earth metals, alkali metals and rare earth, comprising
  (a) a porous carrier substance and
  (b) rhodium, which is provided on the porous carrier substance,
- storing nitrogen oxide during the lean motor operating phase with an air/fuel ratio $\lambda>1$,
- releasing and catalytically converting the nitrogen oxide during the rich motor operating phase with an air/fuel ratio $\lambda>1$,

wherein the porous carrier substance is comprised of at least 50 wt.% zirconium oxide, titanium oxide, silicon oxide or a zeolite or a mixture of two or more of these compounds.

10. Process according to Claim 9, wherein a second noble metal, for example Pt, Pd, or Ir, or a mixture of noble metals, is provided upon the porous carrier substance.

11. Process according to Claim 9, wherein the solid is in the form of a pellet or extradite, or is provided upon a geometric carrier.

12. Process according to Claim 9, wherein the noble metals are provided as atomic mixture upon the porous carrier substance.

13. Process according to Claim 9, wherein the noble metals are respectively individually applied upon the same or different porous carrier substances.

14. Process according to Claim 13, wherein the noble metals are respectively individually applied upon the same or different porous carrier substances to form a powder mixture.

15. Process according to Claim 13, wherein the respective noble metals applied on identical or different porous carrier substances are provided upon a geometric carrier in layers.

16. Process according to Claim 14, wherein the noble metals are respectively applied individually upon the same or different porous carrier substances are provided separately from each

other upon different, for example serially arranged, geometric carriers.

REMARKS

The specification and claims have been amended to conform the original translated specification and claims to U.S. requirements, i.e., appropriate section headers are added, reference in the specification to the claims have been amended in order to eliminate multiple dependent claims and claims improperly depending from multiple dependent claims, and to otherwise conform the claims to U.S. practice. Care has been taken to ensure that no new matter is added to the text.

Entry and favorable consideration prior to consideration are respectfully requested.

Respectfully submitted,

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EXPRESS MAIL CERTIFICATE

"EXPRESS MAIL" MAILING LABEL NUMBER: **EL435909455US**

DATE OF DEPOSIT: **July 24, 2001**

I HEREBY CERTIFY that the foregoing PRELIMINARY AMENDMENT is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated and is addressed: **ATTN: BOX PATENT APPLICATION, Commissioner of Patents and Trademarks, Washington, D.C. 20231.**

The Commissioner is hereby authorized to charge any additional fees which may be required at any time during the prosecution of this application without specific authorization, or credit any overpayment, to Deposit Account Number 16-0877.

Bonnie L. Horst

PROCESS FOR DENITRIFICATION OF EXHAUST GASSES, PARTICULARLY FOR LEAN OPERATED INTERNAL COMBUSTION ENGINES

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The invention concerns a process for denitrification of primarily lean operated internal combustion engines.

Description of the Related Art

[0002] EP 0 890 389 A1 discloses an NOx storage catalytic converter for cleansing the exhaust gasses of vehicle exhaust gas systems. The disclosed storage catalytic converter is comprised of two material components, wherein the one material component serves for intermediate storage of nitrogen oxide during lean operation of the vehicle internal combustion engine and the other material component is a catalytic material with three-way characteristics in which, during short term rich exhaust gas operation, stored nitrogen oxide is released and converted to molecular nitrogen (N_2).

[0003] The required relationship between the lean operating phase and the rich operating phase in the combustion control of the vehicle internal combustion engine is determined by various parameters such as the NOx storage capacity of the material, the amount of NOx arriving, the exhaust gas temperature and, in the case of sulfur-containing exhaust gas, by the sulfur content. In order to achieve a low fuel consumption, it is desired to operate the vehicle internal combustion engine as long as possible with lean operating phases and as briefly as possible with rich operating phases. The NOx storage catalytic converter thus operates discontinuously, since the combustion control of the exhaust gas must be switched alternatingly from lean to rich.

[0004] EP 0 707 882 A1 discloses an NOx storage catalytic converter with an aluminum oxide containing carrier, upon which a

the rich motor operating phase in comparison to the lean motor operating phase, a lower NOx conversion is achieved.

SUMMARY OF THE INVENTION

[0008] It is the task of the invention to provide a process for denitrification of exhaust gasses from primarily lean operated internal combustion engines, which process achieves a good effectiveness even in the case of very short rich motor operating phases.

[0009]

[00010] In the inventive process the porous carrier substance is comprised of at least 50 wt.% zirconium oxide, titanium oxide, silicon oxide or a zeolite, or a mixture of two or more of these compounds.

[00011] The BET-surface of the above-listed carrier substances is preferably between 10 and 500 m^2/g. The rhodium concentration upon the listed carrier materials is preferably 0.1 to 2 wt.%, but can however be appropriately increased or reduced for targeted changes of the solids characteristics.

[00012] For improvement of the nitrogen oxide storage and catalytic characteristics of the process it is possible to supplementally apply one or more noble metals, for example platinum, iridium or palladium upon the porous carrier substance. Thereby the activity of the material may be significantly increased.

[00013] In an advantageous embodiment of the inventive process the nitrogen oxide storing and catalytically effective solid can, commensurate with the intended use, be employed in various forms

[00015] The inventive process is particularly suitable for employment in internal combustion vehicle motors, and in particular diesel motors, stoichiometrically and lean operated Otto motors, as well as gas motors.

BRIEF DESCRIPTION OF THE DRAWINGS

[00016] The invention will be described in greater detail below on the basis of the experimental results with reference to the figures. There is shown:

Fig. 1 the temperature-dependent NOx conversion of an inventive Pt/Rh/ZrO_2-solid in λ-alternating operation,

Fig. 2 the NOx concentration over time using the inventive Pt/Rh/ZrO_2-solid at T=280°C in λ-alternating operation.

DETAILED DESCRIPTION OF THE INVENTION

[00017] During the experiments a lean operating phase of 90 seconds was alternated with a rich operating phase of 4 seconds. The reaction-gas had the following compositions in the lean and rich operating conditions:

	Lean (λ=2.4)	Rich (λ=0.7)
NO	280 Vol.-ppm	280 Vol.-ppm
O_2	12.5 Vol.-%	0 Vol.-%
CO	0.25 Vol.-%	9.3 Vol.-%
H_2	1500 Vol.-ppm	2.6 Vol.-%
Propene	75 Vol.-ppm	2700 Vol.-ppm
CO_2	10 Vol.-%	10 Vol.-%
H_2O	10 Vol.-%	10 Vol.-%
N_2	Rest	Rest